



COLONY OF MAURITIUS

DEPARTMENT OF AGRICULTURE

**Eleventh Annual Report of the
Sugarcane Research Station
1940**

PRINTED AND PUBLISHED BY
J. H. BOWKETT, GOVERNMENT PRINTER.
PORT LOUIS, MAURITIUS, 1941.

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Eleventh Annual Report of the Sugarcane Research Station for the year 1940.

INTRODUCTION

During the year under review, the Cane Breeding Officer, Mr. A. de Sornay, continued his course of studies in England for the B.Sc. Examination of the University of London. Dr. H. Evans proceeded to England on 3rd January on leave of absence, and returned to the Colony on 27th August. Mr. S. Dupont resigned his post as temporary field assistant on 31st January, 1940, and was replaced by Mr. S. Feillafé on 4th March.

Only one meeting of the Research Advisory Committee was held during the year, in February, at which the Annual Report for 1939 and the Research Programme for 1940 were discussed.

Weather conditions for the growth and ripening of the 1940 crop were on the whole good, but were at the same time somewhat abnormal. Rains in the latter part of November and in December, 1939, were satisfactory so that the crop had an early start, but it received a slight set-back as a result of the cyclone of 16th December, 1939. Rainfall continued sufficient during January, February and the first part of March, but it must be noted that the temperature was definitely below normal in the latter two months. Precipitation from 20th March to 10th May was generally deficient, and before the end of this period canes were definitely suffering from lack of water. From 10th May onwards to the end of August, rainfall was abundant and much above the average, and, in addition, temperatures were consistently high, with the result that canes continued growth, and maturity was retarded. From September onwards, to the end of the crop, rainfall was light and below the average, so that vegetative growth was reduced, and maturity hastened. Consequently, at the start of the crop, the sucrose content of the canes was definitely low, but there was a progressive improvement throughout the crop, so that the average for the whole crop was satisfactory.

Rainfall figures for three stations representative of three different localities of the island, together with figures showing the departure from the average temperature at the Central Experiment Station are given in the following

table. These figures have been supplied by the Statistician of the Department of Agriculture.

	<i>Pamplemousses Experiment Station</i>		<i>Central Experiment Station, Reduit.</i>				<i>Royal College, Curepipe</i>	
	<i>Rainfall</i>		<i>Rainfall</i>		<i>Temperature above (+) or below (-) normal °C</i>		<i>Rainfall</i>	
	<i>Average</i>	<i>1940</i>	<i>Average</i>	<i>1940</i>			<i>Average</i>	<i>1940</i>
	<i>ins.</i>	<i>ins.</i>	<i>ins.</i>	<i>ins.</i>			<i>ins.</i>	<i>ins.</i>
January	... 9'56	3'18	10'32	5'81	0'0		16'33	8'96
February	... 8'74	9'72	10'95	9'70	-0'7		17'28	36'69
March	... 9'32	9'39	11'94	4'64	-0'7		19'31	14'81
April	... 5'96	2'23	5'41	1'56	0'0		12'39	3'49
May	... 4'48	20'63	4'24	11'50	+0'9		9'86	25'88
June	... 3'43	6'18	3'11	3'74	+0'7		7'47	12'16
July	... 2'93	4'17	2'75	3'92	+0'9		8'57	13'98
August	... 2'59	3'59	2'47	2'90	+0'9		7'79	11'56
September	... 1'83	1'36	1'71	1'56	+0'6		5'78	5'58
October	... 1'95	1'66	1'91	1'69	+0'7		4'32	2'92
November	... 2'13	1'42	2'33	1'44	+0'6		5'71	3'27
December	... 4'91	2'41	6'39	10'05	+0'6		9'71	11'38
Total	... 57'83	65'94	63'53	58'51	—		124'52	150'68

In view of a possible scarcity of nitrogenous fertilizers, especially sulphate of ammonia, a scheme was drawn up to regulate the distribution of available stocks to ensure that the maximum benefit would result from their use. The scheme was put into operation in the early part of June, and the Senior Chemist was appointed to administer it. Mr. G. C. Stevenson, Geneticist, was given censorship duties to perform on two afternoons each week.

In spite of the absence of certain officers on foreign leave of absence and the extra duties which others were called upon to perform, satisfactory progress was made with the research programme. Brief accounts of the work performed by the several divisions are given in the following pages.

N. CRAIG,
Officer in charge,
Sugarcane Research Station.

PART I—GENETICIST'S DIVISION

CANE BREEDING—M./40 SERIES

Conditions were very favourable for cane breeding; the crossing programme, which had been drawn up before the arrowing season, was carried out almost in its entirety. All crosses were controlled, so that the resulting seedlings are all of known parentage. The bulk of the breeding work was done at Reduit, though a few crosses were made at Pamplemousses Experiment Station. Slight modifications were made to the breeding lanterns, so that by the insertion of cloth faces on their northern sides, the breeding arrows were not subjected to undue insolation during the mid-day hours. The importance of using as female varieties only those which are completely male-sterile has been stressed by the writer in previous reports; during the arrowing season, sex determinations were made for 176 varieties and new seedlings to determine their status as breeding canes.

The breeding programme was one of great interest. In addition to noble cane breeding (*Saccharum officinarum*), nobilisations of the following *Saccharum* species were also made: *S. spontaneum* (Javan, Indian and N. Celebes types), *S. barberi*, *S. sinense* and *S. robustum*. Some inter-specific crosses made in particular breeding lines involved the use of parents containing the blood of as many as three and four of the above species types. It is impossible to give in the present report a detailed list of the crosses made, but the following summarised list will give information on the range of parental types, and the extent to which the several species were employed. The term "cross" should be understood to signify a combination of two known parents in breeding—two or more female arrows were frequently used in a single lantern, and two or more lanterns of the same cross were made in the cases of proven parental combinations, or where the cross was particularly promising for some definite reason.

		No. of crosses made	No. of lanterns used	No. of seedlings obtained	No. of seedlings planted	
					C.E.S.	P.E.S.
I Noble cane breeding (<i>S. officinarum</i>)	...	17	21	17,399	2,499	1,686
II Nobilisation of <i>S. spontaneum</i> —	...					
A. Java type (112 chromosomes)						
"glagah":						
3rd nobilisation	...	4	4	478	268	108
4th nobilisation	...	5	7	105	52	0
5th nobilisation	...	23	34	26,454	3,333	2,115
6th nobilisation	...	4	4	730	270	132
Mixed "glagah" crosses	...	5	7	3,740	558	409
B. N. Celebes type (80 chromosomes):						
3rd nobilisation	...	2	2	25	20	0
C. Indian type (64 chromosomes):						
1st nobilisation	...	1	3	579	174	0
2nd nobilisation	...	1	1	6	6	0
3rd nobilisation	...	3	6	1,841	246	208
III Nobilisation of Chunnee (<i>S. barberi</i>):						
2nd nobilisation	...	1	2	11	11	0
Mixed <i>barberi</i> crosses	...	3	3	102	72	0
IV Nobilisation of Uba (<i>S. sinense</i>):						
1st nobilisation	...	2	2	7	7	0
2nd nobilisation	...	2	2	3	0	0
V Nobilisation of <i>S. robustum</i> :						
1st nobilisation	...	1	1	200	61	68
VI Crosses involving several <i>Saccharum</i> spp.						
A. <i>S. officinarum</i> , <i>S. spontaneum</i> (Java)						
and <i>S. spontaneum</i> (India)	...	15	21	6,367	1,570	1,311
B. <i>S. officinarum</i> , <i>S. spontaneum</i>						
(Java) and <i>S. spontaneum</i> (N.	...	2	2	286	100	88
Celebes)	...					
C. <i>S. officinarum</i> , <i>S. spontaneum</i>						
(India) and <i>S. barberi</i>	...	3	5	158	135	0
D. <i>S. officinarum</i> , <i>S. spontaneum</i> (Java)						
and <i>S. sinense</i>	...	4	6	189	104	27
E. <i>S. officinarum</i> , <i>S. spontaneum</i> (Java)						
and <i>S. barberi</i>	...	2	3	23	22	0
F. <i>S. officinarum</i> , <i>S. spontaneum</i>						
(Java), <i>S. spontaneum</i> (India) and	...	2	5	907	144	253
<i>S. barberi</i>	...					
G. <i>S. officinarum</i> , <i>S. spontaneum</i>						
(India), <i>S. barberi</i> and <i>S. sinense</i>	...	1	1	4	4	0
H. <i>S. officinarum</i> , <i>S. spontaneum</i>						
(Java) and <i>S. robustum</i>	...	1	1	175	78	81
Totals	...	104	143	59,789	9,734	6,486

Germination was very satisfactory except in some inter-specific crosses where incompatibility of chromosomal complements was to be expected on genetic grounds. The seedlings made good early growth and a representative population was planted in the field at Central Experiment Station and Pamplemousses Experiment Station in December. In allocating field plantings, crosses of proven value were generally given larger space than new experimental crosses, which were only represented by sufficient individuals to allow of assessing their value for future breeding. The numbers of seedlings planted in the field are given in the above table.

Experiments on the induction of polyploidy by the drug colchicine are referred to in a later section of this report.

First Year Trials—M./39 Series

First year trials are important not only in that they represent the initial stage of a rigorous testing scheme covering several years, but also because their results provide data for progeny testing, which is the most satisfactory method of assessing the value of parent varieties for breeding. The selection method in use at present has been described by the writer in previous annual reports. During the season selections were made at Réduit in October and November, when 67 seedlings were allocated for further trial ; and at Pamplemousses in November, when 15 seedlings were selected. The relatively small number of selections is due to the fact that in 1939 the breeding work was considerably restricted on account of the scarcity of arrows.

The main breeding lines are directed towards the productions of superior seedlings for testing against the commercial varieties in general cultivation. In addition, a special project was begun during the year in connection with the production of improved seedlings for testing under conditions where fundamental infertility of soil makes cane cultivation difficult. Complex hybrid seedlings bred from the Co. varieties, the early P.O.J. series and the Uba Marot derivatives have been put into second year trials in this scheme, and in the breeding programme detailed above, the crosses under VI should provide some suitable seedlings in which the blood of *S. robustum* and *S. sinense* has been introduced.

Second Year Trials

These include seedlings of the M./38 series at Pamplemousses Experiment Station and the M./37 series at Réduit, and were planted in July and March respectively. During the crop season, seedlings of the M./37 series were reaped in second year trials at Pamplemousses, and those of the M./36 series at Réduit. A total of twenty seedlings was retained for further testing in third year trials, and all were at the same time included in the gumming disease resistance trial to determine their reaction to this disease.

Third Year Trials

Seedlings selected from the second year trials were planted in third year trials at Pamplemousses in August and at Réduit in October. Two such trials were planted at each Station.

Third year trials represent a most important stage in the testing scheme. Reliable information is obtained on yield and juice quality. The gumming disease trial, which runs concurrently, provides data on the resistance of the seedlings included in the third year trials. Seedlings selected from these trials are regarded as being worthy of extended trial in particular regions of the Island. They have generally outyielded the standard varieties in sucrose per acre at Réduit and Pamplémousses: the standards now in use include the new commercial varieties M.171/30, M.72/31 and M.134/32.

During the crop season, four third year trials were reaped in virgin canes, and three in ratoons. Four seedlings were selected, and planted in multiplication plots to provide material for future variety trials: these are M.36/35 (P.O.J.2878 x M.109/26), M.95/35 (M.20/16 x Selangor Seedling), M.163/36 (M.73/31 x D.109), and M.195/35 (M.73/31 x M.37/26). In the ratoon trials, the varieties M.112/34, M.177/35 and M.185/35, which were selected in the previous season and are now in variety trials, gave excellent performances. A fourth selected variety, M.178/35, arrowed very heavily, and has been discarded.

Variety Trials

A comprehensive series of new variety trials was laid down to test the varieties M.88/34, M.112/34, M.177/35, M.185/35 and M.163/36 under a wide range of environments. The trials are at Solitude, Beau Plan, Médine, Union (Ducray), Union (Flacq), Henrietta (Réunion), Beau Bois (St. Aubin), and Sans Souci. These promising varieties represent examples of various growth types and distinct differential responses are expected between the yields of particular individuals at the various trial sites. After the 1941 crop, the release of one or more of these varieties for commercial cultivation will be considered.

During the reaping season, three varieties of the M./33 series were cut in variety trials. These were M.168/33, M.211/33 and M.213/33, all of which were at a late stage in their preliminary trials when the writer arrived in Mauritius in 1938. They all gave rather poor performances in general, though M.168/33 is being further tested at one estate in the higher region of Grand Port, where its performance was moderately good.

Apart from these varieties, the trials reaped were mainly concerned with the performance of the three released varieties M.171/30, M.72/31 and M.134/32, particularly in ratoons. Growth conditions and rainfall distribution during the season are described in the introductory section of this report, by the Officer in charge of the Sugarcane Research Station. It will be noted that canes were somewhat unripe at the beginning of the crop, but ripening subsequently progressed rapidly. Owing to the necessity for brevity in this report, it is impossible to give the results of the trials in full: the sucrose per arpent figures for the three varieties in question, and the standard varieties, are given in the following summary:—

I.—VIRGINS

	M.171/30	M.72/31	M.134/32	B.H.10(12)	White Tanna	P.O.J.2878
Pierrefonds	... 9'05	... 9'05	... 8'01	... 6'75	...	...
Labourdonnais	... 3'86	... 3'85	... 5'03	... 2'97	...	...
Benarès	... 6'19	...	... 6'80	...	...	...
Union Park	... 3'97	...	... 3'76	...	...	...

II.—RATOONS.

		M.71/30		M.72/31		M.134/32		B.H.10 (12)		White Tanna		P.O.J.2878
Britannia	...	5.65	...	5.48	...	5.73	...	—	...	—	...	4.58
Beau Séjour	...	4.71	...	4.16	...	4.61	...	4.49	...	3.78	...	—
Savannah	...	6.45	...	7.21	...	8.42	...	5.03	...	—	...	—
Deep River	...	5.22	...	4.02	...	5.87	...	3.54	...	2.86	...	—
Beau Champ	...	6.89	...	6.07	...	5.79	...	—	...	—	...	5.33

A rather detailed account of the performances of these three varieties during three crop seasons in various districts of the Island, and incorporating recommendations as to the districts best suited for their cultivation, has been prepared for publication in the *Revue Agricole*.

Disease Resistance Trials

The gumming disease trials, details of which have been given in previous reports, were continued during the year: the seedlings under test at present are those of the M./36 and M./37 series which are included in the third year trials, and their reaction to the disease will have been established before these trials are harvested.

The necessity for a reliable method of testing new seedlings for red rot disease resistance has long been recognized. Preliminary experiments are now in progress, and it is hoped that a satisfactory testing scheme may be worked out. The problem is not a simple one, as resistance probably varies in a single variety with the age and physiological condition of the canes, and is complicated by the presence or absence of borers, phytalus grubs and certain pathogenic fungi. The writer wishes to acknowledge the valuable co-operation of the Plant Pathologist, Department of Agriculture, in these investigations.

Phytalus Resistance Trials

The large phytalus trial at Britannia was reaped in first ratoons. Of the 13 varieties included, M.134/32 and M.168/32 were significantly better than any of the others. As a phytalus resistance trial, however, it was unsatisfactory owing to low and irregular infestation by the larvae. Several other small trials to test the resistance of M.168/32 in different districts were unsatisfactory for the same reason. Owing to the sporadic distribution of phytalus larvae in infected areas, and the extreme difficulty of forecasting highly infested fields, it appears to the writer that trials consisting of small replicated plots have a very limited value in work on varietal resistance to the pest. Certain other aspects of phytalus resistance work are described in the Botanist's section of this report.

The Origin of Uba Marot

Bulletin No. 17 of the Sugarcane Research Station describes a morphological and cytological investigation into the origin of this variety. It is concluded that Uba Marot is a natural hybrid of a noble cane (80 chromosomes) and the Indian form of *Saccharum spontaneum* (64 chromosomes) which occurs wild in Mauritius. The value of this knowledge in drawing up future breeding programmes is emphasized. During the breeding season a noble cane was crossed with the local *S. spontaneum*, giving abundant seedlings of the Uba Marot type.

Experiments on the Induction of Polyploidy by the Use of Colchicine

The use of colchicine, which can bring about certain alterations in the chromosomal material of plants, is a new tool in the hands of the plant breeder. Various investigators claim to have produced improved sugarcane varieties by this means. During the breeding season, a series of critical experiments was made to assess the value of the technique. Concentrations varying from 0.02 per cent. to 0.20 per cent. of the drug were used both with ungerminated fuzz and with young seedlings. Various types of material, both noble crosses and inter-specific hybrids were subjected to treatment for times ranging from 2 hours to 24 hours. In no case did the treatment cause an improvement in germination of fuzz. Various abnormalities were observed in the treated seedlings, notably dwarfing and broadening of the coleoptile and first leaves; seedlings exhibiting these characteristics generally died after a few weeks. Several hundred treated seedlings have been planted in the field alongside untreated controls, and are under observation. It is hoped to publish a full description of the experiments at a later date.

Export of fuzz

Consignments of fuzz, from various selected crosses, were sent during the breeding season to the Experiment Station of the South African Sugar Association, Natal, to the East African Agricultural Research Station, Amani, Tanganyika, and to the Ministry of Agriculture, Cairo, Egypt.

Acknowledgements

The work of producing improved sugarcane varieties involves co-operation in several respects with the Divisions of the Department of Agriculture. The writer wishes to express his appreciation of the valuable help received in this way during the year.

G. C. STEVENSON,
Geneticist.

RÉDUIT,
31ST DECEMBER, 1940.

PART II—CHEMISTRY

BY N. CRAIG

In general, the work in this Division has followed closely on the lines followed in the previous year, the only extra work undertaken being that of administering Government Notice No. 126 of 1940, for regulating the sale and distribution of chemical fertilizers. Other work performed has included the continuation of the mapping of the main soil types throughout the cultivated parts of the island, further leaf diagnosis studies, the conduct of field experiments dealing with manurial requirements and cultivation practices with canes, and the replacement of the low grade Uba canes varieties in the Lallmatie and St. Julien areas with higher grade varieties.

Soil Mapping

This work has been continued and the initial survey has now been completed with the exception of a part of the district of Flacq. All the soils mapped have fallen within the classification described in the 1939 Annual Report, but it might be mentioned that the soil in the neighbourhood of Brisée Verdière and Bon Accueil is the most immature of all the soils encountered in Mauritius. The continuation of this soil type area towards the sea becomes the Plaine des Roches, an area which is practically not cultivated at all and which is covered with scrub vegetation. At the same time, soil in close proximity to this very young soil type—at Union (Flacq) S.E.—is an immature type approaching most closely to the mature type. Only very few stones are present in this type, but the soils are not very deep like the really mature ones, and the parent rock material is of the porous type whereas the mature soils are derived from the blue basalt.

Foliar Diagnosis

This subject has continued to be the main line of research followed in the laboratory during the year, and with an increasing number of analytical results becoming available a better appreciation of the value of the method becomes possible.

It has previously been suggested that the best time to take samples of leaves is in the months of optimum growth, *i.e.*, February to early April, when the canes are in full vegetation. If canes are lacking in nutritive elements at this time of the year, it is probably too late to make good the deficiency for this growth period, at least for phosphates or potash. The results are however applicable to the following crop, and this is shown by the fact that high correlations have been found between the P_2O_5 and K_2O content of leaves collected in 1939 and of those collected from the same fields in 1940. The actual figures obtained were:—

P_2O_5	...	$+0.78 \pm 0.06$
K_2O	...	$+0.75 \pm 0.07$

In addition it must be noted that mean content of these two plant foods in the leaves and the range of the values for the two seasons 1939 and 1940 are practically the same, as is shown in the following table:—

	1939	1940
	%	%
Average P_2O_5 content	... 0.39	0.38
Range of values for P_2O_5	... 0.49—0.32	0.41—0.31
Average K_2O content	... 2.08	2.06
Range of values	... 2.62—0.81	2.42—0.90

These figures show that the figures obtained for P_2O_5 and K_2O contents in the leaves for any one year after the canes have received their normal dressings of fertilizers may be taken as a reliable estimate as to what they would contain in the following year if they received similar applications of fertilizers. However for the method to be one of absolute value, and not one of merely comparative value, some estimate of the optimum nutrient contents of nutritive elements in the leaves is necessary. As a first indication of the figures for ratoon canes, the analytical results obtained with thirty samples taken from five varieties of canes in localities where it is known that

the yield approaches the optimum and where liberal applications of complete fertilizers have been made, have been grouped together and the average obtained.

The figures so obtained show that for the five varieties concerned (White Tanna, B.H.10/12, M.27/16, M.171/30 and M.134/32 the optimum content of the dry matter of the 3rd leaf samples of ratoons in full vegetation to be:—

		%
N	...	1.38
P ₂ O ₅	...	0.38
K ₂ O	...	2.18

These figures are not strictly applicable to all varieties, although from a practical point of view no very great error will be introduced if they are used for any of the varieties so far studied. Many samples of leaves have been taken for analysis from variety trials conducted by the Geneticist for comparing the nutrient contents of the leaves of different varieties. In the many trials so sampled and analysed, it is worthy to note that in every case without exception M.134/32 has the highest contents of nutrient material, whilst M.171/30 has in every case the lowest. The deviation from the mean given above is not very great as is shown by the following table:—

CONTENTS OF NUTRITIVE ELEMENTS % DRY MATTER OF THE 3RD LEAF

	N			P ₂ O ₅		K ₂ O
M.134/32	...	1.50	...	0.45	...	2.36
Average	...	1.38	...	0.38	...	2.18
M.171/30	...	1.29	...	0.34	...	2.03

From the results at present available, it would appear that equal increments produce progressively less effect upon the yield as they approach nearer to the optimum content. Thus an increase of the P₂O₅ content of the leaf from 0.20 per cent. to 0.25 per cent. would probably result in a larger increase in yield than would raising it from 0.30 per cent. to 0.35 per cent. The varieties B.H.10/12, White Tanna and M.72/31 approach very closely to the average. These figures must be regarded then as the basis for any advisory work on manurial problems. For normal varieties which have not been studied individually, the average figures may be used without the introduction of any very great disturbing factor, but when an individual variety has been studied then the necessary adjustment may be made. It should be borne in mind that these figures refer particularly to the analysis of the 3rd leaves of ratoon canes which have been sampled in the months of maximum growth.

Most of the work in Mauritius with foliar diagnostic methods has been concerned with phosphates and potash, and so far as these two plant foods are concerned, considerable confidence is placed in this method. In 17 phosphate trials with White Tanna and B.H.10/12 canes the coefficient of correlation between the P₂O₅ content of the leaves and the response to phosphate fertilization was found to be -0.69 ± 0.09 , whilst the coefficient of correlation in the case of potash in sixteen trials is -0.89 ± 0.04 . In the case of nitrogen, results available are too few to permit of any recommendations.

That the figures given earlier for the optimum content of plant nutrients in the leaves are fairly accurate is shown by the fact that in manurial trials

practically no response has been obtained from phosphatic or potash fertilizers when P_2O_5 or K_2O contents of the leaves have reached the figures given, *i.e.*, 0.38 per cent. and 2.18 per cent. respectively.

As a corollary to the different amounts of plant foods present in the leaves of different varieties growing in different conditions, it was considered of interest to determine whether these differences persisted in the mature cane stalks. Consequently samples of M.134/32 and M.171/30, *i.e.*, cane varieties with the maximum differences in the leaves, were analysed. Although there was very considerable variation in the N, P_2O_5 and K_2O contents of the leaves from different localities, there was no consistent difference between the two varieties in one locality so far as P_2O_5 and K_2O contents are concerned, but it may be that the nitrogen content of the M.171/30 canes is slightly higher than that of M.134/32 canes.

Field Trials

In view of the fact that many of the trials reaped are primarily of very local interest, only results of general interest will be briefly discussed.

LEVEL OF APPLICATION OF FERTILISERS

This question was investigated in three trials, two of which were situated on estates, whilst the other was at the Central Experiment Station at Réduit.

At both Britannia S.E. and Olivia S.E. there were only two series of plots, one receiving the normal estate treatment and the other double the normal treatment. There was practically no difference between the two series of plots on either estate.

In Trial 69, at the Central Experiment Station, where one series of plots received four times as much fertilizer as the other, very considerable increases were seen with both varieties, amounting to 12.7 tons per arpent with M.134/32 and 16.9 tons with M.171/30.

In the case of estate lands it would appear that the state of fertility of the soil is such that ordinary applications of fertilizers at present in use, in addition to the residues, pen manure, etc., are sufficient to give optimum yields. In the case of soils not in such a high state of fertility increased applications of fertilizers are probably necessary.

The level of application of individual fertilizers was tested in several trials.

At Solitude S.E. the differential treatments consisted of different applications of sulphate of ammonia under irrigated conditions. There were four treatments nil, 100kgs., 200kgs., and 300kgs. of sulphate of ammonia per arpent. The three series of plots receiving sulphate of ammonia showed small increased cane tonnage, but at the same time the sucrose content of the canes was somewhat lowered.

Amount of phosphate and kind of phosphate were tried on three estates. At Industrie S.E. (an estate without a mill) there was a response to the first increment of precipitated phosphate, but no increase with the second increment. At Mon Désert (Moka) S.E. and at Bel Ombre S.E. there was no response whatsoever. The optimum amount of potash was tried on five estates and in all except one small increases were noted, but as with phosphatic fertilizers, the difference in yield between the plots receiving the lowest quantity of potash

and those receiving more was small. These trials therefore tend to confirm the statement above, about the state of fertility of estates.

The maximum response obtained with phosphatic fertilizers was 13.9 tons per arpent and the variation in sucrose content varied between +0.7 per cent. and -0.7 per cent. With potash fertilizers, the maximum response was 7.9 tons per arpent and the variation in sucrose content varied between +1.5 per cent. to -0.3 per cent.

The large increases in yield following application of phosphatic and potash fertilizers were in soils not receiving normal estate treatment or on small planters' lands.

CULTIVATION EXPERIMENTS

The five experiments dealing with earthing up and forking which were described in the 10th Annual Report were continued and in general the results obtained in 1939 have been confirmed by those of 1940. Ten comparisons were available for both earthing up and forking, and in nine cases a slight increase in yield was noted following earthing up, no change being seen in the other. As a result of forking, however, small increases were seen in only six cases, whilst in the other four the yield was slightly depressed.

Of the two sub-soiling experiments described in the previous Annual Report, one had to be abandoned because of phytalus attack. In the other one, situated at Cascade (Rose Belle S.E.) there was practically no difference between the plots which were not subsoiled and those subsoiled in either one or two directions.

In 1938 a trial was started at Beau Champ S.E. to try the effect of different planting distances and different number of cuttings per arpent. There were two planting distances, *viz.*, 5 ft. between rows and 4 ft. between rows, and the number of cuttings planted per arpent were 16,000 and 8,000 for each planting distance. The trial was not reaped experimentally in 1939 because a large proportion of the canes were killed by borer attack, and the result of the reaping of the 1st ratoon crop in 1940 showed that there was practically no difference between the four series of plots.

The Uba Replacement Scheme in the Lallmatie, St. Julien, etc., Area

The work of replacing the low grade Uba de Rich Fund canes in this area has been actively pursued during the year, and a considerable improvement in the cane supplies may be confidently expected in the near future, but a note of warning is necessary. The soils in this area are extremely shallow and of low productivity, and consequently they cannot be expected to give high yields with normal canes. The planters are, therefore, constantly on the look out for canes of high vegetative vigour, in order to get an improved yield per arpent. Unfortunately the majority of such canes are of low sucrose content, so that if the position is not constantly watched, it may suddenly be found that large areas of fresh low-grade canes may be grown. The estates buying canes from this area and those planting canes in close proximity have important duties to perform in this respect, first by controlling the varieties of canes which they receive, and secondly in not planting doubtful canes themselves. Three such canes have been planted in the neighbourhood, namely Canne Cent Tonnes Batard, Co.301 and M.168/32,

and although planters have been advised not to plant them, it is difficult to convince them of the risks they run, when they see them being grown on estate lands.

It is not proposed in this report to give a full account of the experimental work carried out in this area. Suffice it to say, the work has followed fairly closely upon the lines described in the 1939 Annual Report, and that the results obtained are very similar to the ones obtained previously. Thus it has been shown that applications of phosphatic guano give very profitable returns, and that of the higher grade varieties M.134/32 and M.171/30 may be expected to give good results. The two varieties M.27/16 and M.13/18 are also capable of giving satisfactory results.

The replacement of the Uba de Rich Fund canes is proceeding satisfactory, the chief varieties used being M.27/16, M.13/18, M.134/32 and M.171/30. Planting material of the two-former varieties was obtained from the plantings made in 1939, but for the other two it was necessary to obtain from outside sources. All the M.171/30 required was obtained from the Experiment Stations, together with two propagation plots situated in this area. The supply of M.134/32 from the experiment stations was insufficient to meet the demand, and canes had to be brought from other planters. The canes of M.171/30 and M.134/32 were sold at the rate of 3 cents per cane, each cane averaging about 5 or 6 cuttings.

The number of canes of each of these varieties sold are as follows:—

	M.13/18	M.171/30	M.72/31	M.134/32
Number of canes ...	100	8,830	570	36,650

On an average each cane might be expected to give at least five good cuttings. In addition to this supply of planting material, further supplies were obtained from planters both inside and outside the area. As an illustration as to how quickly it may be propagated, one planter had 23 stools of M.134/32 planted in 1938, which provided sufficient for 400 stools in 1939, and in 1940 it was spread to an extent of about 14,000 stools, *i.e.*, the area has been increased by nearly 600 times in two years. It is expected therefore that the areas planted with these varieties will provide all the planting material for future replacement of the Uba, and it is expected that with only few exceptions all the Uba canes will have been eliminated within the periods allowed by law. Other approved varieties will be tried as and when they become available.

That the Replacement Scheme is proceeding satisfactorily is shown by the following figures showing the tonnages of cane sent to the chief factories concerned:—

	1939-40 crop		1940-41 crop
	Tons		Tons
Uba canes ...	17,239	...	14,074
Good varieties ...	65,870	...	77,129

It should be noted that the yields per arpent in 1940-41 were higher than in 1939-40.

Demonstration Plots for other Co-Operative Credit Societies

Four demonstration plots for these societies were continued in different parts of the Island, and as a result improved cultural practices and the

propagation of the new varieties may be expected. La Caverne Co-operative Crédit Society plot, which was reaped in 1st ratoons, once again gave very excellent results, the average yield being 40.3 tons per arpent. The variety M.134/32 was again easily the best variety, with M.171/30 coming second. The plots receiving phosphatic guano gave approximately 3.6 tons more cane per arpent than did the plots receiving none. At Nouvelle France, both varieties M.134/32 and M.171/30 gave satisfactory results, and the plots receiving phosphatic fertilizers gave 8 tons more cane per arpent than the plots receiving none. The other plots have not yet been reaped.

Control of Artificial Nitrogenous Fertilizers

In view of the uncertainty with respect to the supplies of sulphate of ammonia and nitrate of soda for the manuring of the sugar crop due to be cut in 1941, a scheme was evolved, after discussion with the Chamber of Commerce and the Chamber of Agriculture, to ensure that all planters should receive their fair share of the stocks available. In such a way, it was hoped that the sugar crop of Mauritius would derive the maximum benefit from the reduced quantity available. The scheme was put into operation on 3rd June, 1940, and the Officer in charge of the Sugarcane Research Station was entrusted with the administration of the scheme. Little difficulty was been encountered, and the supply of sulphate of ammonia has been sufficient to provide about 60 per cent. of the normal requirements. Nitrate of soda was also included in the scheme, but towards the end of November a large consignment of Chilean nitrate (nitrate of soda and nitrate of potash) was received so that there is no lack of nitrogenous fertilizers for the 1941 crop, although there is a disinclination to use nitrates in the wetter parts of the island because of the danger of the nitrate being leached from the soil during the heavy rainfalls which are liable to occur in the summer months.

N. CRAIG,
Senior Chemist.

PART III—RESEARCH BOTANY

BY H. EVANS

The Botanist was away on European leave from 2nd January to 27th August, 1940, during which time the programme of work drawn up by the Botanist was followed by the Scientific Assistant of the Botanical Division, Mr. A. d'Emmerez de Charmoy.

Progress Report on Experiments on the Time of Application of Fertilizers

The trials carried out on this subject for the virgin or plant crop have been described in the 1939 Annual Report. In the plant crop no significant differences could be detected on typical estate lands from the application of fertilizers at different times. It was not known with certainty whether or not there was a response to fertilizers in general in these trials, the indications from the time of application results being that no responses in fact occurred. It is apparent that if no actual responses to fertilizer dressings occurred, no differences between different times of application could be expected.

In first ratoons one treatment D, was left without any fertilizer dressings whatsoever, in all the trials. The treatments applied in ratoons were as follows:—

- (A) All N, P and K applied one month after harvesting plant crop.
- (B) All P and K applied one month after harvest ; all N, 4 months after harvest.
- (C) All P and N applied one month after harvest ; all K, 4 months after harvest.
- (D) No fertilizer.
- (E) One-third N, P and K one month after harvest ; two-thirds N, P and K, 4 months after harvest.
- (F) All K and N one month after harvest ; all P, 4 months after harvest.
- (G) Half K and N one month after harvest ; half K and N, 4 months after harvest, all P, 6 months after harvest.
- (H) All P one month after harvest, two-thirds K and N, 6 months after harvest, one-third K and N, 8 months after harvest.

The yields obtained in these trials are given below:—

		A	B	C	D	E	F	G	H	Gen. Mean	Sig. diff.
Beau Vallon Trial	...	43.4	40.6	44.2	35.6	39.9	41.1	41.6	36.8	40.2	4.04
Medine Trial	...	45.5	42.7	41.5	40.0	40.8	43.3	41.0	41.5	42.0	4.35
Beau Champ Trial	...	31.8	34.5	35.4	30.5	33.7	31.3	33.0	33.0	32.9	4.50
St. Aubin Trial	...	36.3	38.3	38.2	36.6	37.6	37.3	37.2	37.1	37.3	2.22
Union Park Trial	...	22.2	21.7	22.0	21.2	22.0	22.8	21.7	21.2	21.8	3.37
General mean, all trials	...	35.8	35.6	36.3	32.8	34.8	35.2	34.9	33.9	34.8	1.65

In the first ratoon crop a definite response to fertilizer was proved in only one out of the five trials although in two others, individual treatments occurred which were significantly higher than the no fertilizer plots. The analytical data suggested that only in one trial, *viz.*, that at Beau Champ was there a deficiency of phosphate. In this trial there was some evidence, though not, however, conclusive, that delayed phosphate application resulted in decreased yields. In those trials where the responses were due to nitrogen or potash or both, there is conclusive evidence that delayed applications of nitrogen and potash caused a significant reduction in yield. The general indication from all the trials is that there is no difference between times of application of potash and nitrogen if applied within four months of the harvesting of the virgin or plant crop. The cause of this is undoubtedly the particular climatic conditions of Mauritius, in that these months generally coincide with a dry and somewhat cool season during which cane growth is low. There is no advantage in splitting the dressings of fertilizer for ratoons, and in the irrigated trial (Medine) the whole application made one month after harvest was actually superior to delayed or split dressings.

In so far as results to date are concerned, it would appear that a single fertilizer dressing applied about one month after harvesting the plant crop, followed by earthing up of the stool is the most economical practice. Further evidence is, however, necessary, fully to substantiate this conclusion. These trials are being continued together with new factorial experiments on time of application of fertilizers in plant cane.

Trash Burying Trials

Descriptions of experiments to judge the efficacy of various methods of trash disposal have been given in previous annual reports. These trials have

been continued at Colmar and Benares S.E., and a new trial has been harvested at Bel Air St. Felix S.E. The yields obtained in 1940 are given below:—

	Yields, tons per arpent		
	Colmar	Bénares	Bel Air St. Félix
Trash buried alone ...	24.25	31.5	29.8
Trash buried with 50kgs sulphate of ammonia per arpent ...	24.20	29.6	32.1
Trash buried with 100-150kgs sulphate of ammonia per arpent ...	—	30.75	—
Trash buried with 30kgs. Guano, 30kgs. nitrate of potash per arpent ...	23.75	33.03	30.9
Controls (trash heaped on surface of interline) ...	23.2	30.71	31.6
Significant Difference ...	1.78 tons	2.10 tons	2.7 tons

The following trash burying experiments have now been harvested: (1) Union Park S.E., harvested in 1938; (2) Colmar, harvested in 1938, 1939 and 1940; (3) Benares S.E., harvested in 1938, 1939 and 1940; (4) Bel Air St. Felix S.E. harvested in 1940. In these trials the following methods of burying the trash were included: (1) Buried in two furrows alongside stool; (2) Buried in one furrow in the middle of the interline; (3) Buried in holes. In addition the following fertilizer treatments were included: (1) 50 kilos, 100 kilos and 150 kilos sulphate of ammonia incorporated with the trash before covering; (2) The same quantities applied on the surface of the soil above the trash after covering; (3) 30 kilos phosphatic guano plus 30 kilos nitrate of potash incorporated with the trash before covering. The controls included trash heaped on the surface of alternate interlines and also trash heaped on the surface of every interline.

In all the trials reaped to date no beneficial effect of burying trash has been demonstrated either in individual trials or when the results of several trials are combined. Treatments in which trash was heaped on the surface yielded as well as treatments in which the trash was buried, irrespective of the method of burying. Occasional small responses to the additional fertilizers applied with the trash were obtained, but even these were uneconomical. These trials will be continued for another year but will be confined purely to the issue of burying trash against heaping on the surface. It would appear, however, that under Mauritius conditions no benefit from burying trash is apparent in trials repeated for three years.

Planting in Furrows Versus Planting on Ridges in Wet Districts

It often happens that in very wet districts cane planted in furrows may be waterlogged for several days following heavy rains. A purely exploratory experiment was, therefore, laid down at Tivoli, Britannia S.E., in which planting the cane in furrows was compared with planting the cane on ridges the furrows between the ridges being available for drainage and for the disposal of trash, which was placed in these furrows (but not covered) after the trashing operations. The variety was B.H.10/12 and there were seven replications of plots 20 holes x 3 rows. The yields were as follows:—

Ridge planting	Furrow planting	Difference
29.3 tons p.a. ...	26.2 tons p.a. ...	3.1 tons p.a. (significant)

The difference in yield of 3.1 tons per arpent was significant at $P=0.05$.

The Influence of Time of Planting on Tiller Formation and on the Mortality of Shoots

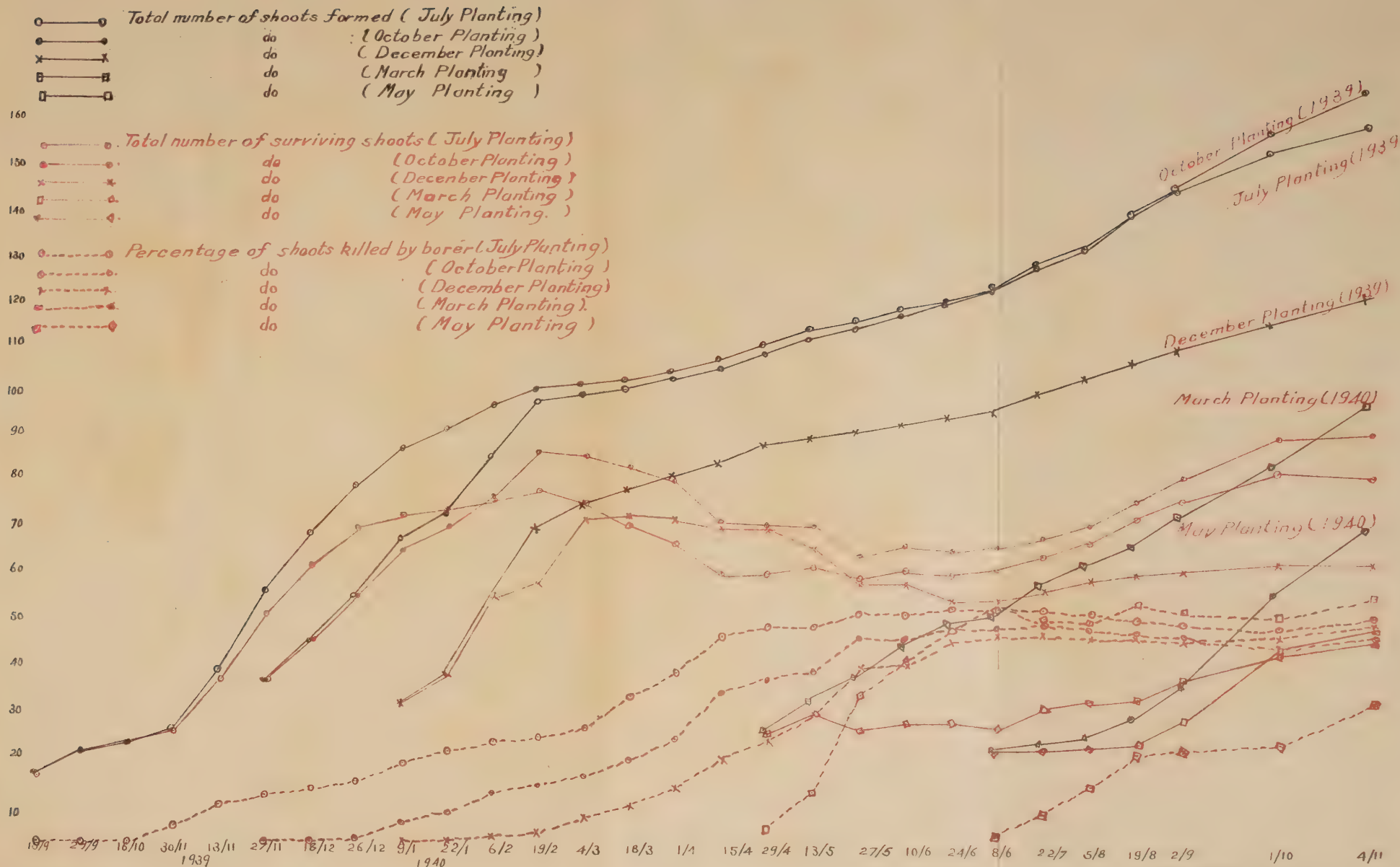
In 1939 a trial was laid out by the Senior Chemist and the Entomologist to determine the influence of time of planting on *Phytalus* resistance. The variety used was M.168/32, the locality, Colmar, Britannia S.E., and the lay out consisted of a 5 x 5 latin square the plot size being six rows of 20 holes of which only the four middle rows were harvested. Plantings were made in July, October and December, 1939, and in March and May, 1940. Use was made of this trial to determine the influence of time of planting on the rate and course of tillering and on the mortality of shoots. Some evidence was previously available that young tillers with dead hearts were not always victims of borer attack and information on this matter was wanted, particularly on the cause of mortality if this was not borer, and on the relative importance of the loss of shoots from causes other than borer. In each plot, a 10 feet length of row was demarcated and every shoot which appeared within this length was tagged, its date of appearance recorded, and its condition checked at fortnightly intervals. If, and when, death of a shoot occurred, it was removed and the cause of death recorded. The *Phytalus* Investigation Officer of the Entomological Division co-operated in the work.

It may be stated at the outset that no mortality of shoots from obscure causes occurred in this trial. Cane borer was responsible for the vast majority of shoots which perished. In the early stages a few shoots died following fungus or bacterial attack: in all cases these were located at or in close proximity to the cut end of the sett, and rotting of the sett for a short distance from the cut ends isolated such shoots so that they were deprived of water and food material from the cutting and subsequently rotted. Other instances were seen of shoots which developed from buds near the soil surface under moist conditions but owing to subsequent drying out of the soil surface, never produced roots and ultimately shrivelled up. The operation of weeding and cultivation was responsible for the death of a small proportion of shoots and a few of the more advanced tillers were killed by red rot. A very small number of shoots died as a result of the operations of the leaf roller (*Marasmia* sp.).

The preponderating influence of borer as a factor in mortality is shown by the fact that of the total number of shoots which perished, 89.7 per cent. were killed by borer, a further 3.4 per cent. were killed in ordinary cultivation practice, and 0.6 per cent. by red rot, leaving only 6.3 per cent. for all other causes such as failure to develop roots, fungus or bacterial attack, etc.

Total Tiller Formation

The course of tiller formation for the different times of planting (means per unit of 10 feet length of row) are plotted in Fig. 1. It is apparent from these curves that there is an epoch of maximum tiller formation which is mainly dependent on the time of the year, *i.e.*, on climatic conditions, but also to a considerable degree on the stage of development of the plants. Thus in the July planting, the rate of tillering was comparatively low until the end of October—beginning of November, when the rate rapidly increased.



This rapid rate continued until the middle of January, there being a subsequently lower rate of tiller formation for the period up to the beginning of July, 1940, when the rate increased again. This latter increase was undoubtedly a response to borer attack which had reached its maximum by the period May-June.

In the October planting the rapid rate of tiller formation had already commenced at the end of November. This was due to the far more rapid germination of the October planted cuttings, resulting in their reaching the stage of rapid tiller formation much sooner than the July planting. The period of rapid tiller formation continued until the middle of February, by which time they had caught up with the July planted material as regards number of snoots. There was here also an increase in tillering from July onwards resulting from borer attack.

Rapid tillering also commenced about six weeks after planting in the December planted material but this rapid rate only continued until the middle of February. There seems to be no obvious cause for the reduction in the rate of tillering in the latter half of February, which occurred in all the plantings. The number of tillers in the December planted material thus never reached that of the July and October plantings. There was a similar increased tillering following borer attack in this planting also.

In the March (1940) planting, the period of rapid tillering was much less well defined than in the three plantings discussed above, partly because the actual rate of tiller formation was less owing to the deteriorating climatic conditions, since the high temperatures and high rainfall of the summer months were past, and partly because the increased rate occasioned by borer occurred almost immediately after termination of the period of maximum tillering.

Finally, the rate of tillering in the May (1940) planted material remained low until the end of August when favourable climatic conditions permitted a rapid increase.

Climatic conditions, influencing the rate of germination of the cuttings and their early growth, thus control the attainment of that stage of development at which rapid tiller formation can occur. This stage of development is reached in about six weeks under the most favourable conditions, but may be delayed for 3-4 months during the cooler winter months. The length of the epoch of rapid tiller formation is dependent on the plant and on the climatic conditions. It does not appear to exceed $2\frac{1}{2}$ -3 months even when the climatic conditions continue to be favourable. On the other hand, it may be much shorter than this when the climatic conditions cease to be favourable (*e.g.*, in the December planting it only lasted for 1 month, owing to a drop in both temperature and rainfall).

Number of Existing Shoots

In both the July and October plantings the initial maximum number of existing shoots occurred in the middle of February; in the December planting

a month later. At these dates the number of canes killed by borer (which had been steadily increasing) became higher than the number of new shoots produced, and continued at a higher rate until the end of May, resulting in a pronounced decrease in the number of existing shoots. It is interesting to note that the percentage of shoots killed by borer attained a substantially constant rate in the July (1939), October (1939), December (1939) and March (1940) plantings, the only exception being the last planting (May 1940), though by November, 1940, even this planting was rapidly approaching the others. The time at which the maximum borer mortality rate was reached was mostly independent of the time of planting and occurred about the end of June, 1940, for all plantings. This mortality rate of 45-50 per cent. of the shoots continued to the end of the season in November.

The high mortality rate undoubtedly induced the increased tiller formation apparent in all the different planting times, since the increased rate of tillering commenced at the beginning of July, 1940, soon after the borer casualties had reached their maximum. This late tillering brought the total number of shoots to a value about equal to the previous maximum reached several months earlier. The fact that the number of shoots was high, however, does not mean that the damage caused by borer had been made good since these new shoots were formed too late to be harvested in the current year. It is also not possible accurately to assess the exact loss caused by borer since the mortality of certain shoots following borer attack may influence the growth of the healthy shoots.

Composition of Harvested Crop

Of the five planting dates only the first three, *viz.*, the 1939 plantings were ready for harvest in the 1940 crop season. The final mean yields per arpent in the three plantings calculated from the total plot yields and from the 10 feet samples were as follows:—

	<i>Yields from total plot weights</i>		<i>Yields calculated from 10 ft. samples</i>	
July planting	...	36.3 tons	...	38.5
October planting	...	37.8 do	...	39.3
December planting	...	31.6 do	...	33.4

In the 10 feet samples in which the canes were tagged the weight of such harvestable cane was determined. From the total weight of cane in each 10 feet length of row, it is possible to calculate the yields per arpent. These were closely correlated with the true yields, being about 5-6 per cent. higher in all three plantings.

In all cases by far the greatest proportion of the harvested crop consisted of canes produced up to the end of the maximum tillering period. Thus in the July planting 95.7 per cent. of the harvested canes were formed during this period, in the October planting, 96.3 per cent.; and in the December planting, 86.0 per cent. Irrespective of any compensating effect of borer attack on new tiller formation, the loss of canes formed during the period

specified above must have a very depressing effect on final yields. The magnitude of such losses is shown by the following data:—

	<i>Number of canes produced in the period up to the end of active tillering</i>			<i>Number of these persisting until harvest time.</i>
July planting	...	100	...	34.0
October planting	...	97	...	33.8
December planting	...	69	...	30.4

It does not of course follow that all the shoots formed during this period would have persisted until harvest time had they not been attacked by borer. It is reasonable to suppose in view of the large number of new tillers that were subsequently formed, however, that a considerably greater number of such shoots would have persisted to harvest time than the number actually found.

In this experiment, the intensity of borer attack was such that the number of surviving shoots was approximately equal, irrespective of the total number formed, *i.e.*, the higher the number of shoots produced, the greater the number destroyed by borer. The total number of harvested canes per foot of row irrespective of time of formation was thus remarkably constant being 3.44 canes per foot in the July planting, 3.50 in the October planting and 3.46 in the December planting. The higher yields in the July and October plantings as compared to the December planting was thus not caused by a higher number of canes, but by the fact that the surviving canes had been formed earlier and thus having had a longer growing period, weighed more.

For the particular climatic conditions existing during the course of this trial, there was no advantage in planting in July as compared to planting in October, but further work is necessary to establish the generality of the conclusion for this environment.

Investigations on the Resistance of Sugarcane Varieties to Borer Damage

The work which was described in the 1939 Annual Report at Colmar, Britannia S.E., was continued on a larger scale during the year 1940.

Borer data taken by the Entomological and Botanical Divisions included all the varieties in the trial with the exception of St. Felix, instead of for five varieties only as in 1940. The restricted data of 1939 had indicated a relationship between the borer resistance of the five varieties for which data were available and the lignin content of the leaf sheath, the correlation coefficient obtained (-0.91) being significant at the 1 per cent. point.

The borer data taken at harvest was extensive, approximately 6,000 canes were examined and the percentage stalk infestation, percentage joint infestation and the intensity index (mean number of punctures per bored joint) determined. These different indices of borer damage are fairly closely correlated with each other the correlation coefficients being $0.87-0.88$ and fully significant at the 1 per cent. point.

The lignin content of adequate samples of young tillers, leaf sheaths, and rind was determined at intervals during the growing season in the Botanical Division. The data are summarised in the table below:—

Variety	% Stalk infestation	% Joint infestation	Intensity Index	Lignin content					
				Young tillers		Leaf sheath		Rind	
				% dry matter	% fresh matter	% dry matter	% fresh matter	% dry matter	% fresh matter
M.108/30 ...	77.8	9.5	2.42	15.2	1.59	20.1	2.64	18.9	7.6
M.14/26 ...	72.0	9.5	2.32	15.8	1.82	17.9	2.84	17.0	5.9
S.A.3(Co.290)...	58.2	6.1	1.68	15.8	2.18	18.6	3.46	15.4	7.1
M.72/31 ...	60.0	6.6	2.08	15.9	1.97	17.9	2.91	16.7	5.1
M.27/16 ...	81.8	10.3	2.90	15.8	1.69	18.5	2.48	17.0	5.8
P.O.J. 2727...	59.0	6.0	1.87	15.9	2.05	17.6	2.87	15.1	5.4
M.73/31 ...	92.3	20.7	3.35	15.1	1.73	16.7	2.31	12.6	4.1
P.O.J. 2878...	62.0	8.2	2.12	17.4	2.00	17.2	2.85	15.6	5.3
M.168/32 ...	72.3	7.5	2.27	15.8	1.63	15.8	2.13	16.6	6.3
S.C. 12/4 ...	49.0	4.1	2.05	16.9	2.26	18.1	3.02	19.6	8.1
M.171/30 ...	69.0	8.7	2.55	16.8	1.99	16.7	2.94	18.4	7.1
M.134/32 ...	68.8	7.2	2.15	16.8	1.67	17.3	2.46	17.4	6.4

There is a significant relationship between the lignin content and borer resistance, whatever the index taken for the latter (per cent. stalk or joint infestation or intensity index). The correlation coefficient is always considerably higher when the lignin content is expressed as a percentage of the fresh material, as would, in fact be expected.

The correlation coefficient between lignin content per cent. dry matter of young tillers and leaf sheath and the percentage stalk infestation is -0.593 , as compared to a value of 0.57 required for significance at the 5 per cent. point, while the correlation coefficients between lignin content of young tillers and of leaf sheaths on a fresh weight basis and borer damage is -0.71 , and -0.72 respectively (-0.74 for the mean values). These latter coefficients are fully significant at the 1 per cent. point.

True lignin content is more highly correlated with borer resistance than material insoluble after digestion of the dry matter in 1 per cent. HCl. Lignin content of the leaf sheath is also more closely correlated with borer damage than lignin content of the rind. This might be due to two causes: (1) the difficulty of obtaining exactly comparable samples of rind tissue; and (2) the possibility that the type of borer which does most damage in Mauritius bores through tissue enveloped by leaf sheaths rather than directly into the rind of dry leaf cane. Even the correlation coefficient between lignin content of the rind and borer damage (-0.57) is, however, just significant at the 5 per cent. point.

These results thus fully confirm the preliminary data obtained in 1939, that resistance of sugarcane varieties to cane borer is dependent on the relative proportion of lignified tissue in the leaf sheath and rind of the cane. This factor controls the hardness of the leaf sheath and rind and thus determine the relative ease with which the borer can penetrate the tissues. Of the varieties included in this trial S.C.12/4 and S.A.3 (Co. 290) were the most resistant, and M.73/31 and M.27/16 the most susceptible.

The results of this investigation indicate that it is possible to forecast the borer resistance of new varieties from adequate determinations of the lignin content of the tissues.

Experiments on the Diagnosis of Nutrient Deficiencies in Sugarcane

Several lines of approach have been used with a view to determining the most practicable physiological or agronomical method for the diagnosis of the nutrient requirements of sugarcane. The chief methods which have been explored to date are:

(1) *Leaf diagnosis*, in collaboration with the Chemical Division. In the Botanical Division the nutrition of the canes in the time of application of fertilizer experiments has been followed using this method, together with the composition of the leaves of canes growing in special nutrient deficient plots. Owing to the fact that no marked differences in the composition of the leaves were found, only small and occasional differences in yield were obtained in the time of application of fertilizer experiments. These results are of value in at least indicating that where no differences in the mineral composition of the leaves are found, no differences in yield are found either. In the few

instances where significant differences in yield occurred, small differences in the composition of the leaves were generally found. At Réduit, the surface soil was removed over a large area in order artificially to induce deficient mineral conditions in the soil. Canes were planted directly in the subsoil and given the following treatments: (1) Complete fertilizer (N, P and K), minus N, minus K, minus P and no fertilizer. The difference in the growth of the canes was remarkable, those in the complete fertilizer plots had a normal appearance, though growth was rather reduced, those in the $-K$ plots showed substantially less growth and potash deficiency symptoms were apparent in the older leaves, those in the $-N$ plots were markedly subnormal and the leaves were yellow in colour; those in the $-P$ plots were the poorest the shoots being small and few in number and the leaves yellow: those in the no fertilizer plots were similar to those in the $-P$ plots.

Analysis of the third leaf gave the following composition for the different treatments:—

		NPK		—N		—K		—P		—O
N % dry matter	...	1.56	...	1.26	...	1.60	...	1.48	...	1.24
K ₂ O % dry matter	...	1.92	...	1.90	...	0.62	...	1.88	...	1.48
P ₂ O ₅ % dry matter	...	0.26	...	0.27	...	0.27	...	0.19	...	0.24
Total (N + P ₂ O ₅ + K ₂ O)	...	3.74		3.43	...	2.49	...	3.55	...	2.96

These analyses were thus in full accord with the growth of the canes and also demonstrate the effect of unbalanced fertilizer additions in accentuating still further the deficiency of a third nutrient.

(2) *Leaf injection.* A considerable amount of work has been carried out on the injection method developed by Roach for the diagnosis of nutrient deficiency. The movement of dyes following injection into sugarcane leaves has been followed for various methods of injection. Although the movement of dyes is very satisfactory and methods of injection which result in injection of known parts of the leaf have been worked out no responses to the micro-injection of mineral substances have been demonstrated. In the canes grown in the plots from which the surface soil had been removed (see (1) above) leaf injections of N, K, P, Ca, Mg, and all the important minor elements produced no visible effects. Concentrations of 0.05 per cent. – 0.5 per cent. of each substance were tried and all leaves from the spindle to the oldest leaves were injected. The substances injected actually found their way into the tissues, but no development of normal leaf colouring followed the injection. In the minus N plants injected with nitrogen there was a profuse development of *Cercospora* leaf spot in the injected half of the leaf.

It is possible that failure to produce a response in sugarcane leaves by local leaf injections may be due to the quick transference of the substance injected to the growing point or other location where the substance in question is in urgent demand. Similar negative results with the leaf injection technique on plants known to be deficient in certain elements were obtained by Hill and Roach (1940)*.

* H. Hill and W. A. Roach. *Annals Bot. N.S.* Vol. IV, No. 15, p. 503, July, 1940.

For one stool of each treatment, the deficient element was added to the soil. This application resulted in a spectacular recovery of the treated plant within 3-4 weeks. In all cases the plants became green and healthy and new tillering was active.

A large number of injections through the cane stalk followed by growth measurements and leaf analysis were made during the year in localities known to be deficient in one or more minerals. These injections seldom resulted in an increased growth rate and very often resulted in a decrease in the growth.

This subject is still under investigation and a complete report of the results obtained will be published elsewhere.

Analysis of exudate from cut canes.—Only a few preliminary determinations have been made on the analysis of exudate from differently fertilized cane.

It appears, however, that the composition of the exudate is correlated with the availability of the element in the soil. The following analytical results were obtained on the exudate of canes treated with complete fertilizer as compared to unfertilized controls (mgms. per 100 c.c. exudate).

		N.P.K.		No fertilizer	
P ₂ O ₅	...	0.064	mgms.	...	0.032 mgms.
K ₂ O	...	0.102	do	...	0.062 do
N	...	1.484	do	...	—

Further work is necessary to determine the value of this method in the diagnosis of deficiencies.

Phythus Resistance Investigations

Progress reports on the resistance of sugarcane varieties to *Phythus* have been published in recent Annual Reports (1938, 1939). The scheme of research which was initiated in 1937-38 has now been completed and has given fundamental information on the factors which constitute resistance to the pest. The large scale trials at Côte d'Or and at Colmar, Britannia S.E., under *Phythus* conditions have been harvested again in 1940. *Phythus* surveys were carried out as in previous years under the direction of the Entomologist. Concurrently, intensive investigations of root behaviour with particular reference to those factors which have been shown to induce resistance (see 1938 Annual Report) were carried out by the Botanical Division. Root systems of each variety at each locality were examined at bi-monthly intervals, and in particular, the number and type of new white roots present at each examination was recorded. The canes were separated as in previous years, and were planted in moist soil after the roots had been pruned off and the number of root primordia kept in reserve and capable of germinating as a result of this root pruning recorded. The large number of canes so treated enabled very accurate estimates of the recovery power of the root system as evidenced by the number of new roots produced, to be made. At the same time the root excavations enabled the course of such new root formation to be followed under natural conditions. The two methods of

approach yielded results which were in complete agreement, for new roots were uniformly produced throughout the season in those varieties which held a large number of reserve primordia. The results obtained at Côte d'Or and at Colmar completely confirmed results obtained in previous years, which are recorded in the 1939 Annual Report.

In the Côte d'Or trial the root data indicated the variety M.73/31 as being the best *Phytalus* resisting variety of the canes included in that trial, although the final yields of this variety were very poor owing to an attack of red rot. In the year 1940,, this variety suffered to only a negligible degree from red rot. It is interesting to note that in the absence of this disease it gave the highest yields, confirming its *Phytalus* resisting powers. The yields of the varieties in 1940 were as follows:--

	M.72/31	Selangor seedling	M.108/30	S.C.12/4	P.O.J. 2727	P.O.J. 2878	B.H. 10/12	M.73/31	Gen Mean
Yields (tons per arpent) ...	26.3	14.9	26.1	13.8	26.6	24.2	6.5	37.0	21.9

Significant difference = 3.3

Thus M.73/31 was significantly superior to all other varieties; there was no significant difference between M.72/31, M.108/30, P.O.J. 2727 and P.O.J. 2878, while Selangor seedling, B.H. 10/12 and S.C. 12/4 were significantly poorer than all the other varieties.

Correlation coefficients were calculated between final yields under these *Phytalus* conditions and the number of reserve primordia in each variety in the periods March–April, May–June, July–August, and means for the whole season. The results are given below:—

CORRELATION COEFFICIENTS BETWEEN NUMBER OF RESERVE PRIMORDIA IN EACH VARIETY AT DIFFERENT PERIODS OF THE YEAR AND FINAL YIELDS

Period March–April ...	+0.800	(sig at 1% point)
Period May–June ...	+0.802	(do do)
Period July–August ...	+0.571	(sig. at 5% point)
Whole season ...	+0.775	(sig at 1% point)

A similar high correlation coefficient of +0.76 was obtained during the investigations on the virgin or plant crop. It is apparent that a lower coefficient was to be expected for the period July–August, since the crop was actually harvested in October. There is, therefore, no doubt that the yield of cane produced under *Phytalus* conditions is dependent on the reserve power of the root system, a character which may be expressed as the number of root primordia held in reserve and capable of germinating under the stimulus of root pruning induced by *Phytalus*.

In the Colmar (Britannia S.E.) trial, similar data were taken as obtained at Côte d'Or. The growth of this trial in 1940 was much more uniform than in 1939, when root diseases seriously affected some varieties. The variety M.73/31, however, suffered severely from red rot. The results of this trial in 1940 are given in the Geneticist's report.

Determinations of the number of root primordia held in reserve in the varieties included in the trial, were made in the periods April–May, June–July,

August–September, each period being a month later than at Côte d'Or. The correlation coefficients between number of root primordia at these periods and final yields were as follows:—

Period April–May	...	+0.68	(sig. at 1% point)
Period June–July	...	+0.66	(almost sig. at 1% point : fully so at 2%)
Period August–September	...	+0.31	(not significant)
Over whole growing season	...	+0.70	(sig. at 1% point)

Here again the correlations between the number of root primordia and final yields are fully significant, though the last determination in August–September was so near the harvesting date (September) that a high coefficient could not be expected.

It is considered that these results which, it is hoped, will be published fully elsewhere, have finally elucidated the most important botanical characters which convey resistance to *Phytophthora*, although further research may show minor factors which might be concerned in the problem of resistance. As regards the resistance of varieties the Sugarcane Research Station seedlings M.168/32, M.134/32, M.171/30 and M.73/31 show highly satisfactory resistance, although of these, M.73/31 is too susceptible to red rot to warrant planting and M.168/32 has not been officially released owing to its doubtful richness. The varieties M.134/32 and M.171/30, which have a very high resistance to *Phytophthora* have been officially released, while the variety M.72/31 which is satisfactory in other respects, has a fairly high resistance to *Phytophthora* (of the same order as P.O.J.2878), though not as high as the varieties mentioned above.

Routine growth measurements of new varieties and subsidiary investigations were also carried out in the Botanical Division which, owing to lack of space, will not be reported here.

H. EVANS,
Botanist.

APPENDIX

List of Publications of the Sugarcane Research Station, Department of Agriculture, Mauritius

I. REPORTS

- Report on a visit to the Proefstation-Oost-Java in March-April, 1930, by A. Glendon Hill. (out of print).
First Annual Report, 1930. (out of print).
Second Annual Report, 1931.
Third Annual Report, 1932.
Fourth Annual Report, 1933. (out of print).
Fifth Annual Report, 1934.
Sixth Annual Report, 1935.
Seventh Annual Report, 1936.
Eighth Annual Report, 1937.
Ninth Annual Report, 1938.
Tenth Annual Report, 1939. .

II. BULLETINS

- Bulletin No. 1—*
(a) Results of Manurial Experiments harvested in 1931 and 1932 ;
(b) Results of Variety Trials harvested in 1931 and 1932 ; by N. Craig, m.sc. (1933).
Bulletin No. 2—
Preliminary investigations of the growth rate of the Sugarcane ; by A. Glendon Hill, B.A., B.AGR., A.R.C.SC.I., and H. Evans, ph.D. (out of print). (1933).
Bulletin No. 3—
Some preliminary data concerning the best shape and size of plot, for field experiments with Sugarcane ; by H. Evans, ph.D. (out of print). (1934).
Bulletin No. 4—
Some properties of the sugarcane soils of Mauritius ; by N. Craig, m.sc. (English and French editions). (out of print). (1934).
Bulletin No. 5—
Studies on root exudation and root type in Sugarcane ; by H. Evans, ph.D. (out of print). (1935).
Bulletin No. 6—
Investigations on the root system of sugarcane varieties ; by H. Evans ph.D. (out of print). (1935).
Bulletin No. 7—
Investigations on the course of growth in a virgin or plant crop of sugarcane ; by H. Evans, ph.D. (1935).
Bulletin No. 8—
The maintenance of first-year characters in new sugarcane clones ; by A. Glendon Hill, B.A., B.AGR., A.R.C.SC.I. (1935).
Bulletin No. 9—
Base exchange relationships in Mauritius soils ; by N. Craig, m.sc. (1935).
Bulletin No. 10—
Some data on the effect of a late heavy dressing of nitrogenous fertilizer on the growth and metabolism of sugarcane in Mauritius ; by H. Evans, ph.D. (English and French Editions). (1936).

Bulletin No. 11—

Sugarcane in Mauritius: A review of the present position with respect to its cultivation and manuring ; by N. Craig, M.Sc., (English and French Editions). (1937).

Bulletin No. 12—

Further investigations on the root-system of sugarcane ; by H. Evans Ph.D. (English and French Editions). (1937).

Bulletin No. 13—

An annotated catalogue of sugarcane varieties in Mauritius ; by A. Glendon Hill, B.A., B.Agr., A.R.C.Sc.I. (1937).

Bulletin No. 14—

A preliminary study of root characters as affecting drought resistance in two sugarcane varieties and in their seedlings ; by H. Evans, Ph.D.

Bulletin No. 15—

The inheritance of gumming disease resistance in sugarcane breeding ; by G. C. Stevenson, B.A. (Cantab.), A.I.C.T.A. (1939).

Bulletin No. 16—

A botanical and agricultural description of some sugarcane varieties raised by the Sugarcane Research Station, Mauritius ; by H. Evans, Ph.D., and G. C. Stevenson, B.A. (Cantab.), A.I.C.T.A. (1939).

Bulletin No. 17—

An investigation into the Origin of the sugarcane variety Uba Marot ; by G. C. Stevenson, B.A. (Cantab.), A.I.C.T.A.

The spread of new varieties of sugarcane in Mauritius ; by N. Craig, M.Sc. (1940).

For publications of the Department of Agriculture, other than those of the Sugarcane Research Station, applications should be made to the Director of Agriculture, Reduit

